

Listing of Claims

1. (Currently Amended) A computer-executable method of ~~controlling the coupling of multiple multi-platform~~ reservoir and network ~~simulations~~ simulators comprising:

providing an open message-passing interface that communicates with black oil model reservoir simulations, compositional model reservoir simulations, and different types of surface ~~network~~ network simulations;

initiating a first reservoir simulation for one or more physical parameters of a first reservoir ~~in a first reservoir simulator~~, the first reservoir simulation using a first fluid model;

initiating a second reservoir simulation for the one or more physical parameters ~~of in a second reservoir in a second reservoir simulator~~, the second reservoir simulation using a second fluid model;

initiating a network simulation to model a network for coupling the first reservoir and the second reservoir to a surface facility;

selecting maximum synchronization intervals to limit controller time steps;

defining network balancing times based on the controller time steps;

applying the controller time synchronization steps via the open message-passing interface to the advancement through time of the first reservoir simulation, ~~executing on a first computing device and the second reservoir simulation executing on a second computing device, and the network simulation,~~ each controller time synchronization step enabling different simulation tasks the first reservoir simulation, the second reservoir simulation, and the network simulation to each take a different number of non-identical time steps to advance to the start of a next controller time step, wherein each simulation task of the first reservoir simulation and the second reservoir simulation advances independently

~~to the next synchronization step using corresponding time steps and Newton iterations uniquely suited to the individual simulation task;~~

varying the duration of the controller time steps in response to a production rate or an injection rate of the first reservoir simulation or the second reservoir simulation;

translating via the open message-passing interface each of a first hydrocarbon fluid stream of the first reservoir simulation and a second hydrocarbon fluid stream of the second reservoir simulation to a common fluid model of [[a]] the controller by converting pseudo-components of each of the first hydrocarbon fluid stream and the second hydrocarbon fluid stream to a super-set of pseudo-components used in the first reservoir simulation simulator and the second reservoir simulation simulator; and

initiating network balancing at a corresponding point in each controller time step.

~~performing a production operation based on the first reservoir simulation of the first reservoir simulator and the second reservoir simulation of the second reservoir simulator, the first reservoir simulation performed on the first computing device and the second simulation performed on the second computing device using the converted hydrocarbon fluid streams.~~

2. (Currently Amended) A controller for coupling multiple multi-platform reservoir and network simulations simulators comprising:

means for interfacing via open message-passing with different types of simulation tasks including black oil model reservoir simulations, compositional model reservoir simulations, and different types of surface networks simulations;

means for initiating a first reservoir simulation for one or more physical parameters of a first reservoir ~~in a first reservoir simulator~~, the first reservoir simulation using a first fluid model;

means for initiating a second reservoir simulation for the one or more physical parameters ~~of in a second reservoir in a second reservoir simulator~~, the second reservoir simulation using a second fluid model;

means for initiating a network simulation to model a network for coupling the first reservoir and the second reservoir to a surface facility;

means for selecting a maximum synchronization time to define controller time steps and network balancing times based on the controller time steps;

means for applying the controller time synchronization steps to the advancement through time of the first reservoir simulation, ~~executing on a first computing device and the second reservoir simulation executing on a second computing device~~, and the network simulation, each controller time synchronization step enabling the first reservoir simulation, the second reservoir simulation, and the network simulation different simulation tasks to each take a different number of non-identical time steps to advance to the start of a next controller time step; ~~— wherein each simulation task of the first reservoir simulation and the second reservoir simulation advances independently to the next synchronization step using corresponding time steps and Newton iterations uniquely suited to the individual simulation task;~~

means for dynamically adjusting the duration of the controller time steps when a production or injection rate in one of the simulations changes beyond a selected threshold;

means for translating each of a first hydrocarbon fluid stream of the first reservoir simulation and a second hydrocarbon fluid stream of the second reservoir simulation to a common fluid model of the controller by converting pseudo-components of each of the first hydrocarbon fluid stream and the second hydrocarbon fluid stream to a super-set of pseudo-components used in the first reservoir simulation simulator and the second reservoir simulation simulator; and

means for network balancing at a corresponding point in each of the controller time steps.

~~means for performing a production operation based on the first reservoir simulation of the first reservoir simulator and the second reservoir simulation of the second reservoir simulator, the first reservoir simulation performed on the first computing device and the second simulation performed on the second computing device using the converted hydrocarbon fluid streams.~~

3. (Currently Amended) The controller of claim 2 additionally comprising means for balancing the coupled ~~multi-platform~~ reservoir simulations ~~simulators~~, including means for apportioning global production and injection rates between the simulation tasks of the first reservoir simulation ~~simulator~~ and the second reservoir simulation ~~simulator~~.

4. (Currently Amended) The controller of claim 3 additionally comprising means for balancing the coupled ~~multi-platform~~ reservoir simulations ~~simulators~~ and the ~~the~~ [[a]] surface network, including means for balancing the surface network with the global production and injection rates apportioned between the simulation tasks of the first reservoir simulation ~~simulator~~ and the second reservoir simulation ~~simulator~~.

5. (Canceled)

6. (Currently Amended) The controller of claim 2, wherein the means for initiating the first reservoir simulation initiates a first reservoir simulation that comprises a black oil model ~~in the first reservoir simulator~~ and the means for initiating the second reservoir simulation initiates a second reservoir simulation that comprises a compositional model ~~in the second reservoir simulator~~.

7. (Currently Amended) The controller of claim 2, further comprising means for coupling additional ~~multi-platform~~ reservoir simulations ~~simulators~~ in addition to the first reservoir simulation ~~simulator~~ and the second

reservoir ~~simulation simulator~~, wherein the additional ~~multi-platform~~ reservoir ~~simulations~~ ~~simulators~~ run a mixture of black oil models with different sets of active phases and compositional models with different sets of pseudo-components.

8. (Currently Amended) The controller of claim 2, wherein the first reservoir ~~simulation, simulator~~ and the second reservoir ~~simulator simulation, and the network simulation~~ run on different ~~computing computer~~ platforms ~~as slave tasks to the controller.~~

9. (Currently Amended) The ~~computer-executable~~ method of claim 1 additionally comprising:

balancing the coupled ~~multi-platform~~ reservoir ~~simulations~~ ~~simulators~~, including apportioning global production and injection rates between the simulation tasks of the first reservoir ~~simulation simulator~~ and the second reservoir ~~simulation simulator.~~

10. (Currently Amended) The ~~computer-executable~~ method of claim 1 additionally comprising:

balancing the coupled ~~multi-platform~~ reservoir ~~simulations~~ ~~simulators~~ and a surface network, including balancing the surface network with the global production and injection rates apportioned between the simulation tasks of the first reservoir ~~simulation simulator~~ and the second reservoir ~~simulation simulator.~~

11. (Currently Amended) The ~~computer-executable~~ method of claim 1, wherein initiating the first reservoir simulation comprises initiating a first reservoir simulation that comprises a black oil model ~~in the first reservoir simulator~~ and wherein initiating the second reservoir simulation comprises initiating a second reservoir simulation that comprises a compositional model ~~in the second reservoir simulator.~~

12. (Currently Amended) The computer-executable method of claim 1, further comprising:

coupling additional ~~multi-platform~~ reservoir simulations ~~simulators~~ in addition to the first reservoir simulation ~~simulator~~ and the second reservoir simulation ~~simulator~~, wherein the additional multi-platform reservoir simulations ~~simulators~~ run a mixture of black oil models with different sets of active phases and compositional models with different sets of pseudo-components.

13. (Currently Amended) The computer-executable method of claim 1, wherein the first reservoir simulation ~~simulator~~ and the second reservoir simulation ~~simulator~~ are run on different computing computer platforms as slave processes to a controller process balancing the slave processes and dynamically varying controller time steps of the slave processes.

14. (Currently Amended) A computer readable storage medium containing instructions, which, when executed by a computer, perform a process comprising:

interfacing via open message-passing with different types of simulation tasks including black oil model reservoir simulations, compositional model reservoir simulations, and different types of surface network simulations ~~network~~;

initiating a first reservoir simulation for one or more physical parameters of a first reservoir ~~in a first reservoir simulator~~, the first reservoir simulation using a first fluid model;

initiating a second reservoir simulation for the one or more physical parameters ~~of in a second reservoir in a second reservoir simulator~~, the second reservoir simulation using a second fluid model;

initiating a network simulation to model a network for coupling the first reservoir and the second reservoir to a surface facility;

selecting a maximum synchronization duration to define controller time steps and network balancing times based on the controller time steps;

applying the controller time synchronization steps to the advancement through time of the first reservoir simulation executing on a first computing device and the second reservoir simulation executing on a second computing device, each controller time synchronization step enabling different simulation tasks to each take a different number of non-identical time steps to advance to a next controller time step; and

dynamically varying the duration of the controller time steps in response to a production rate or an injection rate of the first reservoir simulation or the second reservoir simulation.

~~wherein each simulation task of the first reservoir simulation and the second reservoir simulation advances independently to the next synchronization step using corresponding time steps and Newton iterations uniquely suited to the individual simulation task.~~

15. (Currently Amended) The computer readable storage medium of claim 14, further comprising instructions which, when executed by the computer, perform a process comprising:

translating each of a first hydrocarbon fluid stream of the first reservoir simulation and a second hydrocarbon fluid stream of the second reservoir simulation to a common fluid model of the controller by converting pseudo-components of each of the first hydrocarbon fluid stream and the second hydrocarbon fluid stream to a super-set of pseudo-components used in the first reservoir simulation simulator and the second reservoir simulation simulator; and balancing the network simulation at corresponding points of each controller time step.

~~performing a production operation based on the first reservoir simulation of the first reservoir simulator and the second reservoir simulation of the second~~

~~reservoir simulator, the first reservoir simulation performed on the first computing device and the second simulation performed on the second computing device using the converted hydrocarbon fluid streams.~~

16. (Currently Amended) The computer readable storage medium of claim 14, further comprising instructions which, when executed by the computer, perform a process comprising:

balancing the coupled ~~multi-platform~~ reservoir simulations ~~simulators~~, including apportioning global production and injection rates between the simulation tasks of the first reservoir simulation ~~simulator~~ and the second reservoir simulation ~~simulator~~.

17. (Currently Amended) The computer readable storage medium of claim 14, further comprising instructions which, when executed by the computer, perform a process comprising:

balancing the coupled ~~multi-platform~~ reservoir simulations ~~simulators~~ and [[a]] the surface network simulation, including balancing the surface network simulation with the global production and injection rates apportioned between the simulation tasks of the first reservoir simulation ~~simulator~~ and the second reservoir simulation ~~simulator~~.

18. (Currently Amended) The computer readable storage medium of claim 16, wherein initiating the first reservoir simulation comprises:

initiating a first reservoir simulation that comprises a black oil model ~~in the first reservoir simulator~~ and wherein initiating the second reservoir simulation comprises initiating a second reservoir simulation that comprises a compositional model ~~in the second reservoir simulator~~.

19. (Currently Amended) The computer readable storage medium of claim 16, further comprising instructions which, when executed by the computer, perform a process comprising:

coupling additional ~~multi-platform~~ reservoir simulations ~~simulators~~ in addition to the first reservoir simulation ~~simulator~~ and the second reservoir simulation ~~simulator~~, wherein the additional ~~multi-platform~~ reservoir simulations ~~simulators~~ run a mixture of black oil models with different sets of active phases and compositional models with different sets of pseudo-components.

20. (Currently Amended) The computer readable storage medium of claim 16, wherein the first reservoir simulation ~~simulator~~ and the second reservoir simulation ~~simulator~~ are run on different computing ~~computer~~ platforms as slave processes to a master controlling process.